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SUPERSEDING
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MILITARY SPECIFICATION
SWITCH, ROTARY, SELECTOR POWER,
GENERAL SPECIFICATION FOR

This specification is mandatory for use by all
Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers the general requirements for closed construction rotary switches designed for use in power circuits and capable of making, carrying, and breaking electrical loads of up to and including 10 amperes, unless otherwise specified (see 3.1).

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-N-290	- Nickel Plating (Electrodeposited).
QQ-P-416	- Plating, Cadmium (Electrodeposited).
QQ-S-365	- Silver Plating, Electrodeposited, General Requirements for.
QQ-Z-325	- Zinc Coating, Electrodeposited, Requirements for
PPP-B-566	- Boxes, Folding, Paperboard.
PPP-B-636	- Box, Fiberboard.
PPP-B-676	- Boxes, Setup.
PPP-T-60	- Tape: Pressure-Sensitive Adhesive, Waterproof, for Packaging.
PPP-T-76	- Tape, Pressure-Sensitive Adhesive Paper (for Carton Sealing).

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MIL-M-14	- Molding Plastics and Molded Plastic Parts, Thermosetting.
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MIL-P-116	- Preservation, Methods of.
MIL-P-997	- Plastic-Material, Laminated, Thermosetting, Electrical-Insulating Sheets, Glass Cloth.
MIL-W-5086	- Wire, Electrical 600-volt, Copper, Aircraft.
MIL-A-8625	- Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-P-15037	- Plastic Sheets, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin.
MIL-P-18177	- Plastic Sheet, Laminated, Thermosetting, Glass Fiber Base, Epoxy-Resin.
MIL-M-19833	- Plastic Molding Material and Plastic Molded Parts, Glass Fiber Filled, Diallyl Phthalate Resin.
MIL-C-45662	- Calibration System Requirements.
MIL-I-81023	- Inductor, 28 V D.C. Laboratory Test, General Specification for.

STANDARDS

MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	- Marking for Shipment and Storage.
MIL-STD-130	- Identification Marking of U.S. Military Property.
MIL-STD-202	- Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454	- Standard General Requirements for Electronic Equipment.
MIL-STD-456	- Electronic Parts, Date and Source Coding for.

(See Supplement 1 for list of applicable MS sheets.)

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

3. REQUIREMENTS

3.1 MS Sheets. The individual part requirements shall be as specified herein and in accordance with the applicable MS sheet. In the event of any conflict between requirements of this specification and the MS sheet, the latter shall govern (see 6.1).

3.2 Qualification. Switches, furnished under this specification which are covered by MS Military Standards, listed in the supplement to this specification shall be products which have been tested, have passed the qualification tests specified in 4.5, and have been listed on or approved for listing on the applicable qualified products list, (see 6.3).

3.3 Inspection Requirements for Switches Not Covered by MS Sheets. Unless otherwise specified (see 6.1.2), switches furnished under this specification, not covered by MS Sheets, shall be a product which has been tested and passed the inspection specified in 4.6 unless otherwise specified. In addition, inspection of product for delivery shall be in accordance with 4.7.1.1 and 4.7.1.2.

3.4 Materials. Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the switches to meet the requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4.1 Metals. Metals shall be of a corrosion-resistant type or shall be cadmium plated in accordance with class 2, type II of QQ-P-416; zinc plated in accordance with class 2, type II, of QQ-Z-325; nickel plated in accordance with class 1, type VII, of QQ-N-290; or anodized in accordance with MIL-A-8625, to resist corrosion. Aluminum shall not be used for major structural parts, such as the front plate, bushing, shaft, detent, etc.

3.4.1.1 Contact Surfaces. All contact surfaces shall be silver or silver alloy with a minimum thickness of .002. Terminal surfaces shall be of the same material as the contact surfaces or shall be silver plated to a minimum thickness of .0001, in accordance with QQ-S-365.

3.4.1.2 Ferrous material. Ferrous material shall not be used for current-carrying parts.

3.4.1.3 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals in contact, which tend toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy), is not acceptable. However, metal-plating or metal-spraying of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals are defined in MIL-STD-454, requirement 16.

3.4.2 Plastic.

3.4.2.1 Plastic laminates. Plastic laminates shall be in accordance with MIL-P-997, MIL-P-15037, or MIL-P-18177.

3.4.2.2 Plastic molding. Plastic molding material shall be MAI30, MAI60, SDGF, or MME in accordance with MIL-M-14, and GDI30F in accordance with MIL-M-19833.

3.4.3 Terminal hardware. The terminal hardware shall be as specified (see 3.1). If the terminal hardware is not assembled to the switch, it shall be placed in a bag and firmly secured to the switch.

3.4.4 Mounting hardware. The mounting hardware shall be as specified (see 3.1). For direct government procurement, all mounting hardware shall be assembled in the proper order as shown on the applicable MS sheet.

3.5 Design and construction.

3.5.1 General. Switches shall be of the design, construction, and physical dimensions specified (see 3.1 and 6.1.2). Rotary selector switches, consisting of two or more individual switch elements assembled for operation at the same time, shall be provided with a positive locking means to assure that they will operate as a unit. Switches shall be of closed construction, unless otherwise specified.

3.5.2 Threaded parts. Unless otherwise specified (see 3.1), all threaded parts shall be in accordance with Handbook H28. Wherever possible, unified screw threads shall be used. Where a special diameter-pitch combination is required, the thread shall be of American National Form and of any pitch which is used in the fine-thread series.

3.5.2.1 Engagement of threaded parts. All threaded parts shall engage at least three full threads in soft metals like aluminum and its alloys. A minimum of two full threads shall be used in harder materials such as brass or steel. When a screw mates with a plastic part, a threaded metal insert shall be contained therein.

3.5.3 Mechanical stops (when applicable). Mechanical stops shall be furnished and their positions shall be as specified (see 3.1 and 6.1.2).

3.5.4 Operating shaft. The operating shaft shall be fabricated of steel and shall be insulated from all current-carrying members. The length, shape, and special shaft construction shall be as specified (see 3.1). Unless otherwise specified (see 3.1), the operating shaft shall be 0.250 +0.001 inch diameter.
-0.002

3.5.5 Indexing. Switches shall have a positive detent or indexing mechanism, locating each contact position. The detent or indexing mechanism shall be designed to minimize the possibility of the movable element or elements coming to rest between contact positions. Glass or other fragile materials shall not be used in detent or indexing mechanisms.

3.6 Circuit configuration. When switches are tested as specified in 4.9.2, the switch-circuit configurations shall conform to the applicable diagrams specified (see 3.1). Switches shall make and break the required circuits in all positions and in all sections. In switching make-before-break contact arrangement in either direction, the next subsequent contact throughout the switch shall close before the preceding contacts open. In switching break-before-make contact arrangement in either direction, all closed contacts throughout the switch shall open before any of the contacts in the next position close.

3.7 Strength of mounting bushing (bushing mounted switches only). When bushing mounted switches are tested as specified in 4.9.3, there shall be no damage to the switch, or loosening or twisting of the bushing relative to the switch front plate assembly.

3.8 Torque

3.8.1 Rotational. When switches are tested as specified in 4.9.4 and 4.9.4.1, the torque required to rotate the shaft from each detent position to the next shall be within the specified limits (see 3.1).

3.8.2 Stops (applicable only to switches with stops). When switches are tested as specified in 4.9.4 and 4.9.4.2, there shall be no broken, loose, deformed, or displaced parts, nor shall there be any slippage of moving parts.

3.9 Terminal strength. When switches are tested as specified in 4.9.5, the switch shall be able to operate mechanically and electrically. There shall be no short-circuiting, breakage, or damage to the switch.

3.10 Contact resistance. When measured as specified in 4.9.6, the contact resistance shall not exceed the following values:

Initial.....	10 milliohms
After moisture-resistance test.....	15 milliohms
After life (rotational) test.....	20 milliohms
After salt spray test.....	15 milliohms
After sand and dust.....	50 milliohms

3.11 Thermal shock. When switches are tested as specified in 4.9.7, there shall be no mechanical or electrical damage or loosening of rivets or other fastening devices.

3.12 Vibration. When switches are tested as specified in 4.9.8, mating contacts shall not open for a period of time longer than 10 microseconds (usec) before reclosing. After the test, there shall be no change in shaft position, or evidence of broken, loose, deformed, or displaced parts.

3.13 Shock. When switches are tested as specified in 4.9.9.1, mating contacts shall not open for a period of time longer than 10 usec unless otherwise specified (see 3.1), and when tested as specified in 4.9.9.2, for a period of time not longer than 5 milliseconds unless otherwise specified (see 3.1), before return to the closed position. After the test, there shall be no change in shaft position, or evidence of broken, loose, deformed, or displaced parts.

3.14 Dielectric withstanding voltage. When tested as specified in 4.9.10 to 4.9.10.2 inclusive, switches shall withstand the application of the specified voltages without arcing, flashover, breakdown of insulation, or damage, and there shall be no leakage current greater than 100 micro-amperes.

3.15 Temperature rise. When measured as specified in 4.9.11, the temperature rise at the switch stationary contact shall not exceed 30°C.

3.16 Overload. When tested as specified in 4.9.12, there shall be no mechanical or electrical failure and the switch shall be operative at the conclusion of the test.

3.17 Life. When switches are tested as specified in 4.9.13 to 4.9.13.2 inclusive, they shall be electrically and mechanically operative during and after the test. The contact sequential pattern shall be maintained throughout the test. After the test, there shall be no evidence of broken, deformed, displaced or loose parts.

3.17.1 Switch-section alinement (applicable only to non-shorting switches). When switches are tested as specified in 4.9.13, during the period of monitoring for switch-section alinement, the identical circuits, in all sections of the switch, shall be open for some duration while switching from one position to the next.

3.18 Insulation resistance. When measured as specified in 4.9.14, the insulation resistance shall be greater than 1,000 megohms, except after electrical endurance and moisture resistance testing, the insulation resistance shall be greater than 100 megohms.

3.19 Moisture resistance. When switches are tested as specified in 4.9.15, immediately after conclusion of the test, and with the switches removed from the humidity chamber, the insulation resistance shall be greater than 5 megohms. The insulation resistance measurements shall be completed within 30 minutes after the switches are removed from the chamber. At the end of the drying period the insulation resistance shall be greater than 100 megohms. At the conclusion of the test, there shall

be no evidence of excessive corrosion, breaking, cracking or spalling. Excessive corrosion is defined as corrosion which interferes with the electrical or mechanical performance, or, in the case of plated metals, corrosion which has passed through the plating and attacked the base metal. After the test, mounting and terminal hardware shall be readily removable.

3.20 Salt Spray (corrosion). When switches are tested as specified in 4.9.16, there shall be no evidence of excessive corrosion. Excessive corrosion is defined as corrosion which interferes with the electrical or mechanical performance, or, in the case of plated metals, corrosion which has passed through the plating and attacked the base metal. After the test, mounting and terminal hardware shall be readily removable.

3.21 Sand and dust. When switches are tested as specified in 4.9.17, there shall be no evidence of mechanical or electrical damage.

3.22 Explosion. When switches are tested as specified in 4.9.18, there shall be no explosion within the test chamber, whether or not explosion occurs within the switch.

3.23 Marking. Switches shall be marked in accordance with MIL-STD-130 with the following information:

- (a) MS part number
- (b) Switch manufacturer's name, trademark, or code symbol (the code symbol shall be in accordance with MIL-STD-456).
- (c) Date code in accordance with MIL-STD-456.
- (d) Switch manufacturer's part number. When applicable, the Government drawing number or prime contractor's number shall be marked on the unit package.
- (e) Terminals shall be marked as specified (see 3.1).

3.24 Workmanship. Switches shall be processed in such a manner as to be uniform in quality and shall be free from cracked or displaced parts and other defects that will affect life, serviceability, or appearance. All molded or laminated parts shall be free of chips, blemishes, or flakes which are detrimental to the operating functions of the switch. Gate marks shall not be considered a defect, but flash shall be removed.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government. Calibration of the standards which control the accuracy of the inspection equipment shall comply with the requirements of MIL-C-45662.

4.1.2 Additional inspection. Nothing specified herein shall preclude the supplier from taking such additional samples and making such additional inspection as he may deem necessary or desirable to assure conformance of the switches to this specification.

4.1.3 Government. Acceptance of the switches shall be based upon verification by the Government of the supplier's compliance with the requirements of this specification. The Government may, as its option, repeat any or all of the inspections specified herein.

4.2 Classification of inspection. The examination and testing of switches shall be classified as follows:

- (a) Component-materials inspection (see 4.3).
- (b) Qualification inspection (see 4.5).
- (c) Inspection requirements for switches not covered by MS sheets (see 4.6).
- (d) Quality conformance inspection (see 4.7).
 - 1. Inspection of product for delivery (see 4.7.1).
 - 2. Inspection of preparation for delivery (see 4.7.2).

4.3 Component-materials inspection. Component-materials inspection shall consist of verification that the component materials listed in Table I, used in fabricating the switches, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

TABLE I. Component-materials inspection.

Component material	Requirement paragraph	Applicable specification
Plating.....	3.4.1	QQ-P-416, QQ-Z-325, QQ-N-290, or MIL-A-8625
Plastic.....	3.4.2	MIL-M-14, MIL-P-997, MIL-P-15037, MIL-P-18177, or MIL-M-19833
Silver Plating.....	3.4.1.1	QQ-S-365

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be made under the conditions specified in the general requirements of MIL-STD-202.

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3).

4.5.1 Sample submission.

4.5.1.1 Single submission. For a given MS sheet, the number of samples shall be in accordance with Table II. The samples shall represent a single circuit configuration of the largest number of switch sections (regardless whether the switch is rear supported or not), or shall represent the largest number of sections for which qualification approval is sought. If both rear supported and non-rear supported switches are covered by an MS sheet, four additional samples of the non-rear supported switches having the largest number of sections for which qualification approval is sought, shall be submitted for tests. A separate switch shall be tested under specimen numbers 1, 2, 7, and 8.

4.5.1.2 Group submission. Group submission shall be the same as for single submission except for MS sheets covering more than one circuit configuration. Four additional samples of each circuit configuration shall be submitted for test. The switches shall have the largest number of sections covered by the MS sheet and shall be subjected to the tests covered by specimen numbers 1, 2, 7, and 8. Switches covered by other MS sheets but identical to the switch for which there is qualification or for which qualification is being sought, except for circuit configuration or other acceptable variations, may be included in group submission. The switches shall be subjected to the tests specified for group submission on the MS sheet (see 3.1).

4.5.2 Test routine. Sample units shall be subjected to the qualification inspection specified in Table II, in the order shown. Any switch failing any examination or test in the sequence shall not be subjected to further inspection.

TABLE II. Qualification inspection sequence.

Examination or test	Require- ment para.	Method para.	Specimen numbers									
			1	2	3	4	5	6	7	8	9	10
Visual and mechanical examination	3.1, 3.3 to 3.4.2 incl, 3.5, 3.23 and 3.24	4.9.1 4.3	1	1	1	1	1	1	1	1	1	1
Circuit configuration	3.6	4.9.2	2	2	2	2	2	2	2	2	2	2
Strength of mounting bushing	3.7	4.9.3			3	3						
Torque-----2/-----	3.8	4.9.4	3	3	4	4	3	3	3	3	3	3
Terminal strength----	3.9	4.9.5			5	5						
Contact resistance---	3.10	4.9.6	4	4	6	6	4	4	4	4	4	4
Thermal shock-----	3.11	4.9.7	5	5								
Vibration-----	3.12	4.9.8	6	6								
Shock 3/(as specified)	3.13	4.9.9	7	7								
Overload-----	3.16	4.9.12	8	8								
Electrical life (rotational) 4/	3.17	4.9.13.1										
Resistive load DC--	3.17	4.9.13.1.6							5	5		
Inductive load DC--	3.17	4.9.13.1.2									5	5
Lamp load DC-----	3.17	4.9.13.1.4							6	6		
Resistive load AC--	3.17	4.9.13.1.7							7	7		
Inductive load AC--	3.17	4.9.13.1.3									6	6
Lamp load AC-----	3.17	4.9.13.1.5							8	8		
Temperature rise-----	3.15	4.9.11							9	9	7	7
Moisture resistance--	3.19	4.9.15			7	7						
Sand and dust-----	3.21	4.9.17					5	5				
Explosion-----	3.22	4.9.18					6	6				
Salt spray (corrosion-	3.20	4.9.16					7	7				
Torque-2/-----	3.8	4.9.4	9	9	8	8			10	10	8	8
Dielectric withstand- ing voltage	3.14	4.9.10.1 and 4.9.10.2	10	10	9	9			11	11	9	9
Insulation resistance	3.18	4.9.14	11	11					12	12	10	10
Contact resistance---	3.10	4.9.6	12	12	10	10			13	13	11	11
Mechanical life-----	3.17	4.9.13.2									12	12
Contact resistance---	3.10	4.9.6					8	8			13	13
Strength of mounting bushing-----	3.7	4.9.3					9	9				
Visual and mechanical examination 1/ 6/	3.1, 3.3 to 3.4.2 incl 3.23 & 3.24	4.9.1	13	13	11	11	10	10	14	14	14	14
Circuit configuration	3.6	4.9.2	14	14	12	12	11	11	15	15	15	15

(SEE FOOTNOTES NEXT PAGE)

1. Marking shall be considered defective only if it is illegible at the completion of any of the required tests.
2. Room temperature only. For specimens 3 through 10.
3. As specified.
4. At least a total of two sections must be subjected to each electrical load specified on the applicable MS sheet. Therefore, the number of switches required for this test must be varied depending on the number of sections per switch and the number of electrical ratings specified. At least two switches must be tested regardless of the number of sections per switch with the required number of sections per switch electrically loaded.
5. Room temperature only.
6. Only specimen numbers 3 and 4 shall be inspected for compliance with physical dimensions.

4.5.3 Failure. Failure in any of the applicable examinations or tests shall be cause for refusal to grant qualification.

4.6 Inspection requirements for switches not covered by MS sheets. Inspection requirements for switches not covered by MS sheets shall be performed, after award of contract and prior to production at a location satisfactory to the Government (see 6.1.2). Unless otherwise specified (see 6.1.2), the samples and test routine shall be as specified in 4.5.1, 4.5.2, and Table II.

4.7 Quality conformance inspection.

4.7.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A, B, and C.

4.7.1.1 Inspection lot. An inspection lot shall consist of all switches of the same basic design, same circuit configuration, and same number of sections, and offered for inspection at one time.

4.7.1.2 Group A inspection. Group A inspection shall consist of the examinations, certifications, and tests specified in Table III, and shall be made on the same set of sample units, in the order shown.

TABLE III. Group A inspection

Examination or test	Requirement paragraph	Method paragraph	AQL (percent defective)	
			Major	Minor
Visual and mechanical----	3.1	4.9.1	1.0	4.0
Marking-----	3.23	4.9.1		
Workmanship-----	3.24	4.9.1		
Circuit configuration----	3.6	4.9.2	1.0	---

4.7.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for normal inspection. The acceptable quality levels (AQL) shall be as specified in Table III. Major and minor defects shall be as defined in MIL-STD-105.

4.7.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may withdraw the lot, rework it to correct the defects, or screen out the defective units, as applicable and reinspect. Such lots shall be kept separate from new lots and shall be clearly identified as reinspected lots. Rejected lots shall be reinspected using tightened inspection.

4.7.1.3 Group B inspection. Group B inspection shall consist of the examinations and tests specified in Table IV, in the order shown.

TABLE IV. Group B inspection (2 units for each contact configuration).

Examination or test	Requirement paragraph	Method paragraph
Visual and mechanical examination	3.1, 3.3 to 3.4.2 incl. 3.5, 3.23 and 3.24	4.9.1, 4.3
Circuit configuration-----	3.6	4.9.2
Torque-----	3.8	4.9.4
Contact resistance-----	3.10	4.9.6
Electrical life (rotational)-3/	3.17	4.9.13.1
Resistive load DC-----	3.17	4.9.13.1.6
Lamp load DC-----	3.17	4.9.13.1.4
Resistive load AC-----	3.17	4.9.13.1.7
Lamp load AC-----	3.17	4.9.13.1.5
Temperature rise-----	3.15	4.9.11
Torque-2/	3.8	4.9.4
Dielectric withstanding voltage--	3.14	4.9.10.1
Insulation resistance-----	3.18	4.9.14
Contact resistance-----	3.10	4.9.6
Visual and mechanical examination ^{1/}	3.1, 3.3 to 3.4.2 incl. 3.23 and 3.24	4.9.1
Circuit configuration-----	3.6	4.9.2

1./ Marking shall be considered defective only if it is illegible at the completion of any of the required tests.

2./ Room temperature only.

3./ At least a total of two sections must be subjected to each electrical load specified on the applicable MS sheet. Therefore, the number of switches required for this test must be varied depending on the number of sections per switch and the number of electrical ratings specified. At least two switches must be tested regardless of the number of sections per switch with the required number of sections per switch electrically loaded.

4.7.1.3.1 Sampling plan. Tests shall be conducted on each contact configuration during each 12 month period following qualification.

4.7.1.3.2 Non-compliance. If a sample fails to pass Group B inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the qualification activity has been taken. After the corrective action has been taken, Group B inspection shall be repeated on additional sample units (all inspection

or the inspection which the original sample failed, at the option of the qualification activity). Final acceptance shall be withheld until the Group B reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the qualification activity.

4.7.1.4 Group C inspection. Group C inspection shall be completed in accordance with Table II within 2 years after initial qualification and within each 3-year period thereafter.

4.7.1.4.1 Disposition of sample units. Sample units on all groups B and C tests shall not be delivered on the contract or order.

4.7.1.4.2 Non-compliance. If a sample fails to pass Group C inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the qualification activity has been taken. After the corrective action has been taken, Group C inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the qualification activity). Groups A and B inspection may be reinstituted; however, final acceptance shall be withheld until the Group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the qualification activity.

4.7.2 Inspection of preparation for delivery. Sample packages or packs and the inspection of the preservation packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of Section 5 or the documents specified therein.

4.8 Retention of qualification. In order to retain qualification, the supplier shall forward at 12-month intervals, to the qualifying activity, a certification that all switches produced, and delivered to the requirements of this specification, have been subjected to and have passed Group A inspection, and the complete tests of Group B inspection performed during that 12-month period, and complete Group C tests performed during that 36-month period including the number and type of any part failures of the two respective groups. If the test results indicate nonconformance with specification requirements, requalification will be required unless proof of corrective action for each failure is provided. Failure to submit the test results will result in loss of qualification for that product.

4.9 Methods of examination and test.

4.9.1 Examination of product. Switches shall be examined to verify that the design, construction, marking and workmanship are in accordance with the applicable requirements. Only two of the sample units shall be inspected for compliance with physical dimensions for qualification and Group B testing (see 3.1, 3.4, 3.5, 3.23, and 3.24).

4.9.2 Circuit configuration (see 3.6). Switches shall be tested with suitable test circuits to determine conformance of the actual open and closed switch-circuit conditions, including shorting and nonshorting functions to the applicable diagram (see 3.1).

4.9.3 Strength of mounting bushing (see 3.7). Bushing mounted switches shall be mounted on a metal panel by the normal mounting means with the specified hardware. A torque of 50 pound-inches shall be applied to the mounting nut. Switches shall then be examined for damage and loosening or twisting of the bushing relative to the switch front plate assembly.

4.9.4 Torque (see 3.8). Switches shall be mounted by their normal mounting means.

4.9.4.1 Rotational (see 3.8.1). The torque required to rotate the switch shaft with respect to the switch body shall be measured with a torque wrench or other suitable torque measuring device.

4.9.4.1.1 Room temperature. Switches shall be exposed to a temperature of $+25^{\circ} \pm 10^{\circ}$ C. The maximum values of torque required to rotate the switches through all positions in both directions shall be determined.

4.9.4.1.2 Minimum temperature. Switches shall be exposed to a temperature of $-55^{\circ} \pm 2^{\circ}$ C for a period of 4 hours. Torque readings shall be made and shall be within the limits specified (see 3.1).

4.9.4.1.3 Maximum temperature. Switches shall be exposed to a temperature of $+85^{\circ} \pm 2^{\circ}$ C for a period of 4 hours. The maximum values of torque required to rotate the switch through all positions in both directions shall be determined while the switch is maintained at $+85^{\circ} \pm 2^{\circ}$ C.

4.9.4.2 Stops (applicable only to switches with stops) (see 3.8.2). Unless otherwise specified (see 3.1), a torque of 25 pound-inches shall be gradually applied to the shaft against the stops in clockwise and counterclockwise directions. After this test, switches shall be examined for broken, loose, deformed, and displaced parts and slippage of moving parts.

4.9.5 Terminal strength (see 3.9).

4.9.5.1 Strength of threaded terminal inserts. Threaded terminals shall withstand for 1 minute, the static values of force and torque specified in Table V. The force shall be gradually applied in any direction (including the direction most likely to cause failure). Any one terminal, however, shall be tested in one direction only.

TABLE V. Static values of force and torque.

Thread size	Force in pounds	Torque in lb-in ^{1/}
4-40	5	4.4
5-40	10	7.5
6-32	30	10.0
8-32	35	20.0
10-32	40	32.0
10-24	40	35.0
1/4-28	50	75.0

^{1/} The torque values are intended as a test for terminals and not for terminal hardware. Where brass terminal screws are used, it may be necessary to substitute steel screws for the purpose of this test as torque values exceed shear strength of screws in certain sizes.

4.9.5.1.1 Pull. Terminals of the switches shall be tested in accordance with method 211, test condition A, of MIL-STD-202, and shall be subjected to a pull of the applicable static force specified in Table V. A minimum of five terminals shall be tested.

4.9.5.1.2 Torque. Terminals of the switches shall be tested in accordance with method 211, test condition E, of MIL-STD-202, and shall be subjected to a torque of the applicable terminal thread size specified in Table V. A minimum of five terminals shall be tested.

4.9.6 Contact resistance (see 3.10). Switches shall be tested in accordance with method 307 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Method of connection - Test leads shall be connected by a method suitable for the switch terminals.
- (b) Contact resistance shall be determined using a test current of 100 milliamperes and an open-circuit test voltage of 2 to 4 volts.

- (c) Number of activations prior to measurement - Three.
- (d) Number of measurements - One measurement per switch section. Measurements shall be taken before and after any test on the same contacts.

4.9.7 Thermal shock (see 3.11). Switches shall be tested in accordance with method 107 of MIL-STD-202. The following details shall apply:

- (a) Test condition - A.
- (b) Measurements before and after cycling - Not applicable.
- (c) Examinations after test - Switches shall be examined for mechanical and electrical damage and loosening of rivets or other fastening devices.

4.9.8 Vibration (see 3.12). Switches shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Tests and measurements prior to vibration - Not applicable.
- (b) Mounting - Switches shall be rigidly mounted by their normal mounting means on a rigid metal panel. The mounting fixture shall be free from resonances over the test frequency range. Where mounting brackets are required (see 3.1), they shall be used.
- (c) Direction of motion - One of the directions of vibration shall be in a plane perpendicular to the longitudinal axis of the switch.
- (d) Test condition - C.
- (e) Electrical test conditions - The test circuit shall be in accordance with method 310 of MIL-STD-202, and shall consist of one pair of mated contacts in closed position on each electrical sector (each pole group of contacts, that performs a nonduplicating electrical function) series-connected, with each switch under test set at a different operating position.
- (f) Tests and measurements during vibration - Switch contact stability shall be continuously monitored during vibration. In the event of indication of contact opening greater than that allowed, the vibration cycle shall be continued long enough to monitor contacts, switch by switch, to determine which switch(es) is defective.
- (g) Measurements after vibration - Not applicable.
- (h) Examination after test - Switches shall be examined for change in shaft position, and evidence of broken, deformed, displaced or loose parts.

4.9.9 Shock (see 3.13). Switches shall be tested in accordance with 4.9.9.1, and in addition 4.9.9.2 when specified (see 3.1).

4.9.9.1 Method I. Switches shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Special mounting means - Switches shall be mounted on a rigid metal panel. Where mounting brackets are required (see 3.1), they shall be used.
- (b) Test condition - H.
- (c) Electrical-load conditions - As specified in 4.9.8(e).
- (d) Measurements during shock - Switch-contact stability shall be continuously monitored during shock by means of a test circuit in accordance with method 310 of MIL-STD-202. In the event of indication of contact opening greater than that allowed, the test shall be modified by applying successive identical blows in the same plane to monitor contacts, switch by switch, section by section, to determine if a switch is defective.
- (e) Examination after test - Switches shall be examined for change in shaft position, and evidence of broken, deformed, displaced, or loose parts.

4.9.9.2 Method II. Switches shall be tested in accordance with method 207 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Special mounting means - per figure 207-4a of MIL-STD-202. When mounting brackets or rear mounting through bolts are required (see 3.1), they shall be used.
- (b) Electrical-load conditions - As specified in 4.9.8(e).
- (c) Measurement during shock - As specified in 4.9.9.1(d). Switch-contact stability shall be monitored for each blow. In the event of indication of contact opening greater than that allowed, the test shall be modified by applying successive identical blows in the same plane to monitor contacts, switch by switch, to determine if a switch is defective.
- (d) Measurements after shock - Not applicable.
- (e) Examination after test - Switches shall be examined for change in shaft position, and evidence of broken, deformed, or displaced parts.

4.9.10 Dielectric withstanding voltage (see 3.14). Switches shall be tested in accordance with 4.9.10.1, and when specified (see 3.1), in accordance with 4.9.10.2.

4.9.10.1 At atmospheric pressure. Switches shall be tested in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Magnitude of test voltage - 1,000 volts plus twice rated voltage except that following electrical life test, the test voltage shall be 600 volts rms, 60 Hz (see 3.1). The test voltage shall be maintained and monitored during the test.
- (b) Nature of potential - AC.
- (c) Duration of application of test voltage - For quality conformance inspection, the test voltage shall be applied for a period of 5 seconds. For qualification test and Group C inspection test, voltage shall be applied for 1 minute.
- (d) Points of application of test voltage for each switch
 - (1) The test voltage shall be applied between all current carrying parts of each switch section (one section at a time or all sections simultaneously) and all non-common or grounded metal parts.
 - (2) On multi-deck switches, with the switch in any "on" position, the test voltage shall be applied between all current carrying parts of adjacent switch sections.
 - (3) The test voltage shall be applied between any two adjacent stationary contacts which have been energized during the electrical life tests, on each switch section.
- (e) Leakage current shall be continuously monitored. 100 microampere current flows constitutes failure.
- (f) Examination after test - switches shall be examined for evidence of arcing, flashover, breakdown of insulation, and damage.

4.9.10.2 At reduced barometric pressure. Switches, designed for operation above 10,000 feet, shall be tested as specified in 4.9.10.1 and in accordance with method 105 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Method of mounting - By normal mounting means on a corrosion-resistant panel in the test chamber.
- (b) Test condition - B, unless otherwise specified.
- (c) Test during subjection to reduced pressure - The switch contacts specified in 4.9.10.1(d) shall be tested at 450 volts rms, 60 cycles, unless otherwise specified (see 3.1).

4.9.11 Temperature rise (see 3.15). The temperature rise of any one contact pair per section or wafer of the switch stationary contacts energized during the electrical life test shall be determined by the thermocouple method. The temperature sensitive elements shall be placed on the contacts where they first emerge from the switch body. Following the electrical endurance test, the contacts shall be energized at maximum rated current at any convenient voltage within the switch rating for a period of 4 hours. Following the 4-hour period, and while still energized, the temperature rise measurement shall be determined.

4.9.12 Overload (see 3.16). The switch shall be operated for 50 operations to interrupt 600 percent of rated dc resistive loads specified on the applicable MS sheets (see 3.1). The circuit shall provide for "ON-OFF" switching and one operation shall consist of throwing the switch from the "OFF" to the "ON" position and return to the "OFF" position. The test rate shall be 5 seconds "ON" and 25 seconds "OFF". One position of each section shall be subjected to this test simultaneously.

4.9.13 Life. A switch cycle of operation shall be the movement of the actuating means through the entire range of travel and return.

4.9.13.1 Electrical life (rotational) (see 3.17). Unless otherwise specified, test loads and circuits shall be so arranged that an independent load of the specified current shall be provided for each pole. Unless otherwise specified, for purpose of electrical testing, the standard voltages shall be 28 vdc and 125 vac, 60 or 400 Hz, as specified. The following conditions shall apply:

- (a) Wire - In any of the specified load tests, each conductor shall be of an applicable size for single use in free air as listed in MIL-W-5086. If the switch rating under test does not coincide with a wire size, the next larger diameter shall be used.
- (b) Power supply - Any suitable power supply may be used provided it meets the requirements of this specification.
- (c) Procedure - Switches shall be monitored to determine whether any contact has failed to open or close its individual circuit in the proper sequence. Each individual circuit shall control the specified load at a constant rate and at 10 to 12 cycles per minute. A cycle shall be as specified in 4.9.13. Associated with each load shall be a circuit that will detect operational failure. The monitoring circuit shall not shunt inductive components of inductive loads or switch contacts.

4.9.13.1.1 Loads. Switches shall be subjected to the operating cycles making and breaking the rated load at room temperature, as specified (see 3.1). Details of the test shall be as specified (see 3.1). The loads are as follows:

4.9.13.1.2 Inductive load, dc. Switches shall be subjected to the minimum operating cycles at the rated inductive current at the rated altitude at the dc voltage specified in the MS sheet. Inductive dc loads shall use MIL-I-81023 inductors.

4.9.13.1.3 Inductive load, ac. Switches shall be subjected to the minimum operating cycles at the rated inductive current at the rated altitude at the rated ac voltage specified in the MS sheet. The duty cycle shall be 25 percent "on" and 75 percent "off" \pm 5 percent. The power factor of the ac inductive load shall be $0.50 \pm .05$.

4.9.13.1.4 Lamp load, dc. A tungsten lamp load which provides the rated, steady state lamp current at the rated dc voltage shall be used. The circuit shall be arranged so as to provide a minimum of 15 seconds cooling time preceding each time a lamp is energized. The duty cycle shall be approximately 30 percent "on" and 70 percent "off". Only tungsten lamps having a nominal wattage of 25 to 50 watts, of the voltage specified, shall be used to make up the load. At the option of the manufacturer, a synthetic lamp load shall consist of making ten times the rated lamp load and breaking the rated lamp load. The duration of the ten times inrush shall be .015 second minimum.

4.9.13.1.5 Lamp load, ac. Similar to 4.9.13.1.4, except that the rated ac voltage shall be used. Only tungsten lamps having a nominal wattage not to exceed 200 watts, at the voltage specified, shall be used to make up the load. At the option of the manufacturer, a synthetic lamp load shall consist of making ten times the rated lamp load and breaking the rated lamp load. The duration of the ten times inrush shall be .015 second minimum.

4.9.13.1.6 Resistive load, dc. Only resistive components shall be used.

4.9.13.1.7 Resistive load, ac. Only resistive components shall be used.

4.9.13.2 Mechanical life. Switches shall be subjected to additional operating cycles to equal the minimum mechanical life cycles as specified (see 3.1).

4.9.14 Insulation resistance (see 3.18). Switches shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

- (a) Test condition-B.
- (b) Points of application of test voltage for each switch.
 - (1) The test voltage shall be applied between all current carrying parts of each switch section (one section at a time or all sections simultaneously and all non-common or grounded metal parts.)
 - (2) On multi-deck switches with the switch in an "ON" position, the test voltage shall be applied between all current carrying parts of adjacent switch sections.
 - (3) The test voltage shall be applied between any two adjacent switch contacts which have been energized during the electrical life tests, on each switch section.
- (c) For Group B inspection, the test voltage shall be applied for 15 seconds. For qualification and Group C inspection, the test voltage shall be applied for 1 minute.

4.9.15 Moisture resistance (see 3.19). Switches shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting - Switches shall be mounted on a corrosion resistant metal panel with the shaft in a horizontal position, and with all mounting and terminal hardware assembled to the switch.
- (b) Initial measurement - Not applicable.
- (c) Polarization - During steps 1 to 6 inclusive, a polarization voltage of 100 volts dc shall be applied between two terminals tied together on opposite sides and adjacent to a throughbolt, or terminal adjacent to a grounded metal portion if no through-bolting is used, and the metal panel. Polarization voltage shall also be applied to two other adjacent terminals elsewhere on the switch section. One section of each switch shall be so tested. The negative polarity shall be applied to the metal panel. Steps 7a & 7b are not applicable.
- (d) Loading voltage - Not applicable.
- (e) Final measurements - At the end of the drying period, insulation resistance shall again be measured as specified in 4.9.14.

- (f) Examinations after test - Switches shall be examined for evidence of corrosion, breaking, cracking, or spalling of terminals. Mounting hardware shall be removed at the end of the test.

4.9.16 Salt spray (corrosion) (see 3.20). Switches shall be tested in accordance with method 101 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting - Switches shall be positioned with the operating shaft in a horizontal position. Mounting and terminal hardware shall be assembled to the switch for this test.
- (b) Test condition - B. Applicable salt concentration shall be 5%.
- (c) Treatment after test - Within 10 minutes after test, switches shall be washed for 5 minutes under running water not warmer than 37°C., shaken and lightly brushed as specified in method 101 of MIL-STD-202, then dried for 6 hours in a force-draft oven at 50°C to 60°C.
- (d) Examination after test - Following the drying period the switches shall be examined for evidence of corrosion, warping or other damage. The mounting and terminal hardware shall be readily removable.
- (e) Measurements after exposure - Not applicable.

4.9.17 Sand and dust (see 3.21). Switches shall be tested in accordance with method 110 of MIL-STD-202. The following details shall apply:

- (a) Test condition - B.
- (b) Dust velocity - 2,500 \pm 500 feet per minute.
- (c) Measurements - During the last hour of test, the switch shall make and break its rated resistive load for 500 cycles at the lowest dc voltage.
- (d) Examination after test - Switch shall be examined for evidence of electrical or mechanical damage.

4.9.18 Explosion (see 3.22). Switches shall be tested in accordance with method 109 of MIL-STD-202. The following detail shall apply:

Electrical load - Switches shall be operated with the 28 vdc inductive load specified (see 3.1).

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be level A or C, as specified (see 6.1).

5.1.1 Level A.

5.1.1.1 Cleaning. Switches shall be cleaned in accordance with MIL-P-116, process C-1.

5.1.1.2 Drying. Switches shall be dried in accordance with MIL-P-116.

5.1.1.3 Preservative application. None required.

5.1.1.4 Unit packaging. Unless otherwise specified, switches shall be individually packaged in accordance with MIL-P-116, method III, insuring compliance with the general requirements paragraph under methods of preservation (unit protection) and the physical protection requirements paragraph therein. Unit packages which exceed 20 cubic inches shall be placed in a supplementary container conforming to PPP-B-566 or PPP-B-676.

5.1.1.5 Intermediate packaging. Switches, packaged as described in 5.1.1.4, and whose outer container is not a box, shall be placed in intermediate containers conforming to PPP-B-566 or PPP-B-676. Intermediate containers shall be uniform in size and shape, shall be of minimum tare and cube, and shall contain multiples of five unit packages, not to exceed 100 packages or ten pounds. No intermediate packaging is required when the total quantity shipped to a single destination is less than 100 units.

5.1.2 Level C. Each switch shall be individually packaged in a manner that will afford adequate protection against corrosion, deterioration, and physical damage during shipment from supply source to the first receiving activity.

5.2 Packing. Packing shall be level A, B, or C, as specified (see 6.1).

5.2.1 Level A. The packaged switches shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirement. In lieu of the closure and waterproofing requirements in the appendix of PPP-B-636, closures and waterproofing shall be accomplished by sealing all seams, corners, and manufacturer's joint with waterproof tape, 2 inches minimum width, conforming to PPP-T-60, class 1, or PPP-T-76. Banding (reinforcement requirements) shall be applied in accordance with the appendix to PPP-B-636, using nonmetallic or tape banding only.

5.2.2 Level B. Unless otherwise specified, the packaged switches shall be packed in fiberboard containers conforming to PPP-B-636, class domestic, style optional, special requirement. Closures shall be in accordance with the appendix thereto.

5.2.3 Level C. The packaged switches shall be packaged in shipping containers in a manner that will afford adequate protection against damage during direct shipment from the supply source to the first receiving activity.

5.3 Marking (see 6.1). In addition to any special marking required by contract or order, each unit package, intermediate, and exterior container shall be marked in accordance with MIL-STD-129.

5.4 General. Exterior containers shall be of a minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent possible.

5.5 Inspection. Inspection of military packaging shall be in accordance with MIL-P-116 (see 4.7.2).

6 NOTES

6.1 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) MS part number.
- (c) Whether knobs are required.
- (d) Whether jumper and connecting strip are required.
- (e) Level of preservation and packaging and packing and applicable marking (see section 5).

6.1.1 Indirect shipments. The preservation, packaging, packing, and marking requirements specified herein apply only to direct purchases by or direct shipment to the government and are not intended to apply to contracts or orders between the supplier and prime contractor.

6.1.2 For switch types not covered by MS sheets. Information pertaining to requirements for switches not covered by MS sheets should be obtained from the procuring activity. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Whether inspection is required (see 3.3), and if so:
 - (1) The laboratory at which inspection is to be performed (see 4.6).
 - (2) Samples, submission of data, and test routine, if other than specified (see 4.6).

- (c) Design and construction (see 3.5).
- (d) Threaded parts, if other than in accordance with Handbook H28 (see 3.5.2).
- (e) Operating shafts (see 3.5.4).
 - (1) Length and shape
 - (2) Special construction (e.g., double-flatted, with or without end screw, slotted, etc.).
 - (3) Operating shaft dimensions, if other than specified.
 - (4) Shaft flat angle, if other than specified.
 - (5) Bushing length.
- (f) Circuit configuration (see 3.6).

Drawing to be used for specifying the circuit configurations for each switch section should be in accordance with 3.1 or comparable figure of description.
- (g) Shock:
 - (1) Allowable contact opening during shock (see 3.13).
 - (2) Electrical-load conditions for shock tests, if other than specified (see 4.9.8(e)).
- (h) Torque:
 - (1) Rotational torque limits (see 3.8.1).
 - (2) Stop torque, if other than specified (see 4.9.4.2).
- (i) Mounting brackets, if required (see 4.9.8 and 4.9.9).
- (j) Life, rotational: Electrical and mechanical:
 - (1) Whether reduced barometric pressure tests are required (see 4.9.10) and altitude test condition letter (see 4.9.10.2).
 - (2) Switch section electrical loading conditions (see 4.9.13.1).
 - (3) Cycle rate (see 4.9.13).
 - (4) Temperature conditions (see 4.9.11).
 - (5) Electrical switch section loading condition (see 4.9.13.1.1).
- (k) Dielectric withstanding voltage:
 - (1) Whether reduced barometric pressure tests are required (see 4.9.10.2).
 - (2) Test voltages, if other than specified (see 4.9.10.1(a) and 4.9.10.2(c)).
 - (3) Test condition letter (see 4.9.10.2(b)).
- (1) Jumper and connecting strip (see 3.1).

6.2 Boots and knobs. Boots, when used to provide a panel seal, shall be in accordance with MIL-B-5423. Knobs, when provided, shall be in accordance with MIL-K-3926.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products listed is the Air Force Logistics Command, Attn: SCMES, Wright-Patterson Air Force Base, Ohio, 45433, and information pertaining to qualification of products may be obtained from that activity.

6.3.1 Copies of "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.4 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:

Army - EL
Navy - AS
Air Force - 85

Preparing activity
Air Force - 85

(Project 5930-0509)

Review activities:

Army - EL, MI
Navy - AS, OS, EC
Air Force - 11, 17, 85

Code "C"

User activities:

Army -
Navy -
Air Force -